How to develop the surgical dexterity needed for endoscope neurosurgery?

Jens Haase

Fragment of a straightforward message 1859:
"That one, when in truth shall succeed in bringing a man to a destination, first and foremost you have to be careful to find him where he is and start from there. This is the secret of all art of assistance, and anyone who cannot understand this is conceited when he thinks that he can help others.
Soren Kirkegaard, Danish philosopher." *(p1-8)*

Introduction

"The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honours the servant and has forgotten the gift." Albert Einstein.

Great neurosurgeons like Cushing, Dandy and Olivecrona, are mainly remembered for their fluent performance in the operative room (OR) and for their innovations. Dexterity or motor skills refers to skills and ease in physical manual activity (Adams, McBride, Milton, Shah). Their dexterity was developed through a combination of inborn abilities and dedicated training. They all influenced the development of our neurosurgical societies (Spicer). Present day teachers such as Rhoton, Samii and Yasargil developed early micro-surgical training facilities so that surgeons could practice and develop their surgical skills (Laws, Mumenthaler, Rhoton, Yasargil).

Neurosurgeons learn from colleagues in other medical specialties. This results in that a new tool for minimal invasive neurosurgical procedures has been introduced to neurosurgeons (Pernezky, Tendick). Endoscopes are used for brain surgery of ventricles and subarachnoid spaces. It has recently specifically been advocated to use endoscopes for the very common simple decompressive peripheral nerve surgery carpal tunnel release (CTR), (Agee, Atroshi, Chow, Jimenez, Mumenthaler, Palmer, Scholten). The result of this innovation could be that many neurosurgeons will grab an endoscope and start using it, believing this will benefit their patients. There is often in literature and at conferences a harsh dispute between advocators of CTR performed with endoscope or with conventional open surgery (Haase 2007, Jimenez, Palmer). What is interesting is not the discussion but whether we obtain the same results of CTR using endoscope- or open decompression or not. This is the only way surgeons can reduce eventual mistakes and failures that so far has been too common in endoscope surgery (Evans). This is to learn to use the instrument.

As trainees we try to develop surgical skills to become surgical experts. Surgical performance includes precise control of motor finger/hand function and its regulation on the basis of visual cues, hand-eye coordination and particular tactile experience (Chazan, Schiltz, Waterhouse). The endoscope itself does however introduce some serious problems for us neurosurgeons.

In a "quality"-learning model developed by the Dreyfus brothers, the following five stages of expertise can be found among trainees/MD´s. These 5 stages are:

1. **Novices** - act on the basis of context-independent elements and rules.
2. **Advanced beginners** - begin to take account of situational factors, which they have learned to identify and interpret on the basis of their own experience from similar situations.
3. **Competent performers** - are characterized by the involved choice of goals and plans as a basis for their actions. Goals and plans are used to structure and store masses of both context-dependent and context-

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independent information.

4. **Proficient performers** - identify problems, goals, and plans intuitively from their own experientially based perspective. Intuitive choices are checked by analytical evaluation prior to action.
5. **Experts** - whose behaviour is building on intuitive, holistic, and synchronic judgments in the way that a given situation releases an adequate picture of the problem together with goal, plan, decision, and action in one instant and with no division into phases. This is the level of true human expertise. Experts are therefore characterized by a flowing, effortless performance, unhindered by analytical deliberation.

From our institution, Aalborg University, a 6th level has been suggested relating to this discussion (Flyvbjerg):

6. **Innovator experts** - physicians that also understand the necessity of a debriefing session after a procedure in order to consider the adequacy of old skills in order to develop new ones. Thereby these experts become true innovators of new techniques.

If a neurosurgeon wants to use a new tool e.g. the endoscope, he needs to understand how an endoscope functions and then also learn how to use it in a solid way - all this before he starts using it for operating on patients. The purpose of this paper is to emphasize, that "reflection" is a key word in this process when you learn new techniques such as endoscope surgery (Kolmos).

Neurosurgeons - Personalities and abilities, important instruments for surgery: We all possess some abilities. A neurosurgeon's abilities can be divided into four areas (Haase 2004). We all harbour these four different types of abilities and may become better to develop our skills in "Learning scenarios" by accepting this fact (Fleishman).

Cognitive abilities such as abstract thinking, spatial orientation, and mental imagery. These factors can for instance be important when the surgeon has to form a representation of what an organ looks like when it is rotated (endoscope neurosurgery). Mental imagery is related to perceptual experiences in a given sensory modality. Probably visual imagery is by far the most important mental imagery needed in endoscope surgery. (Waterworth 2003).

Psychomotor abilities include control precision, reaction time, and finger dexterity. Sensory motor skills depend on hand-eye coordination, thus providing the basics for skilled performances as e.g. piano playing and microsurgery (Granscharov, McDonald, Waterworth 1997).

Physical abilities include strength, flexibility, co-ordination and stamina. Endoscope surgery requires a certain degree of physical vigour to sit or stand, perhaps having the neck bend for hours looking at a screen (Fleishman, Madeleine).

Sensory and perceptual abilities include, for example, visual acuity, colour discrimination and depth perception. Today we add technology to support these features to our field by excellent screens and high definition imaging (Arnold, Barnes, Drascic, Kochro, Spicer).

Operative room (OR) and its function:

"Macro"-habitat: When performing operations the neurosurgeon work on a stage - the OR. This stage is a structured field of activity also called a "habitat". Acting subjects e.g. neurosurgeons can inhabit it for a shorter or longer time. We live here in a normal "macro world". In a normal OR = a "macro"- habitat, the patient is placed on the OR table and the surgeon alongside with his instruments. In order to perform a CTR, the surgeon depends upon large volumes of information learned through normal daily life (Haase 2004). A neurosurgeon uses his hands for palpation of body specimens - nerves, brain, and muscles. Entering the OR he has to palpate tissues with "macro"-instruments and he has to learn how this changes his perception through practice. Examples are: How to hold the actual instruments or how to use a pair of scissors? He already knows these functions from normal life and can easily adapt them to his surgical dexterity. How will sounds influence him during surgery? Sounds in the OR come from suction devices, anaesthesiology apparatus, music and the walking and chatting of nurses. These sounds vary from OR to OR. He must learn how sounds influence his performance. In the OR he also has to gain information learned by repetition. Examples are what are the distances from the neurosurgeon at the OR table to different objects in the macro-habitat such as instruments, pledges and the scrub-nurse. With rehearsal of these simple procedures he will very fast feel at home in his OR. With advancing age he may need to use binoculars and in certain situations eventually magnifying glasses (loupes). Thereby he is gradually moving from one habitat into a new habitat - the "micro"-habitat.

"Micro"-habitat: When performing surgical procedures, all neurosurgeons wish them to be as non-invasive as possible. The surgeon wants to see our operative field as good as possible in order to be "a good neurosurgeon". Using loupes he learned that there are technical benefits from seeing better. Therefore the operative microscope (Fig. 1) was introduced (Yasargil).

Neurosurgeons using this thus moved from "macro-" to "micro"-surgery. The use of a microscope was in the early days learned by rehearsal and dedication - being pioneers. Today, many microscopes are very complicated instruments

Figure 1 - The operative microscope.

that he must train with to be able to use in an optimal way. The necessary microsurgical technique needed using a microscope is somewhat different from what we have learned so far, but is still based on our daily macroscopic function. What is new is that we need to learn new manners of behaviour and communication when performing microsurgery. This is something we try to do in the EANS courses (www.EANS.org). With our two eyes we see almost the same through the microscope in a conventional 3 dimensional (3D) view as we do in "macro"-surgery. The main difference is now primarily that we view the operative field better with both magnification and with well-focused light and we therefore see things we did not before. What has really changed is that all our movements viewed through the microscope are "faster" due to the magnification. Additionally we do not see all of our instruments or fingers in this "micro"-habitat, we only see the instrument tips. Furthermore, we cannot communicate freely with our surroundings e.g. the nurses, as our eyes are constantly in contact with the oculars of the operative microscope. We have to keep our eyes there to preserve our necessary eye-accommodation. We are also 'stuck' with the microscope and cannot change positions as easily as when performing macro-surgery. For long lasting microsurgical cases fatigue is an important factor. Some of us may be able to operate for hours without developing fatigue, others will not. Tremor is now more visible and must be controlled. Physical training is needed for all neurosurgeons performing microsurgery (Andersen, Hoell). The magnification gives us access to tasks that seemed impossible in macro-space, e.g. suturing 0.5 mm thick vessels, or dissecting vessels of an aneurysm dome. However, moving from macro- to microsurgical habitat we do luckily only function slightly different and can rather easily adapt to this change.

"Endoscope"-habitat: Endoscopes were introduced in laparoscopic surgery (Gallagher, Tendick). Endoscopes in neurosurgery are mostly used for ventricular surgery, for 3rd ventriculostomy and as an adjunct to aneurysm surgery (Gaab). The inhabitants in this new "endoscope-habitat" are still the neurosurgical team but now working with their completely new set of endoscope instruments. The new habitat is very different from the previous one used. We may have to operate with a twisted body at a distance viewing our operative field via a TV monitor. Using the endoscope and the TV monitor the neurosurgeon has only a 2D vision of the operative field. The most prominent change is that our normal direct 3D vision is failing and thereby the neurosurgeon has to learn a completely new way of perceiving "depths" in contrast to what we do through daily life since childhood. The quality of images obtained through a long instrument may also be less good in certain situations. Endoscope instruments are changed, as we may have to pass our instruments through the endoscope. The instrument lengths, construction and their handles are therefore different from what we have trained with. In endoscope surgery we may be bending our heads for long periods of time and use our isometric muscle function more than ever. This is a factor that craves specific physical training of neurosurgeons neck muscles and not only general fitness training (Andersen).

This new "endoscope habitat" is therefore completely new compared to the well-known macro- and microhabitats. As a consequence, we cannot just use our present - through a long-life - learned operative techniques (Haase 2004, Long, Spicer). We have to learn anew and, therefore we have to validate methods of obtaining these necessary new techniques.

Cortical brain - cognitive - functions:
"Computers/ robots are very fast, precise but also stupid in contrast to man that is unbelievably slow, imprecise and still fantastically intelligent." (Einstein).

Hare brain - Tortoise mind: Cortical function = cognitive function is essential for our surgical performance. We all possess a fast thinking mind, a so-called "hare brain", which is rational, analytic, focused, linear and excellent for the declarative knowledge function (Claxton 1997). Western, or Cartesian understanding of human 'intelligence' is often thought of as deliberate conscious reasoning in traditional academic terms "clever thinking". Neuroscience has recently taught us that an effort made to maintain conscious comprehension could get in the way of a natural learning ability (Claxton 1997, Claxton 2004, Haase 2004, Long). Hence, using our "hare brain" alone will never develop our trainees into becoming true surgical "experts" (Dreyfus). Luckily, the human brain also harbours what is called a "tortoise mind", i.e., a slow thinking mind that is intuitive, unfocused and creative (Claxton 1997). Interplay between these two modes of the mind - hare brain/tortoise mind - is essential to learning (Claxton 2004, Hlustic). Being explicit and strategic are not always the smartest ways to learn surgical performance. Trainees that become too addicted to conscious clarity (hare-brain users) may thereby undermine their creativity (Claxton 2004). If we shall become experts in neurosurgery we need in our surgical training to have more focus on the 'tortoise mind', which - by tradition - is downplayed in our current learning culture, focusing mostly on hare brain and declarative knowledge.

Dexterity training and surgical performance:

This requires various types of knowledge such as theoretical knowledge = "knowing-that", and procedural knowledge = "knowing-how". "Theoretical knowledge" is consciously accessible, so-called declarative information which can be explained either verbally or illustrated symbolically (Adams, Claxton 2004, Dreyfus, Fleishman). Reading books and medical journals and listening to lectures results in obtaining theoretical knowledge. It is evident that much surgical function depends on solid personal backgrounds in knowledge of anatomy, physiology, pathology, different surgical techniques and procedures. This type of knowledge is mainly stored in the hippocampus and provides the surgeon with the rules and principles for his surgical performance. This is therefore an essential part of the "hare brain". This information is very flexible and can easily be forgotten or twisted by time.

"Procedural knowledge" characterizes the surgeon, who performs adequately without following an explicit method - and perhaps even being unable to declare which rules or principles that are being followed. It is thus also called "embodied" knowledge and is mainly stored in parts of the striatum - the putamen - and in the cerebellum where it governs "habit learning". The actual surgical performance often called "dexterity" is created through a "habit-learning" and is therefore mainly a procedural knowledge. It is like learning to play an instrument, the fingers will in the beginning move slowly as our primary brain cortex is processing the movements, while we are learning the "declarative" rules of playing (Kneebone). For dexterity adaptation, motor memory is important (Fuster 1995). A planned behaviour pattern is defined by the goal of the activity and the sequence of movements that leads to this goal. A complex action demands thus a series of in-between and preliminary goals to be reached. Prefrontal recruitment of movements is based on two types of memory. These are the sensory "looking-back" short-time memory and the motor "looking-forward readiness" short-time memory. Prefrontal neurons activate neurons in the premotor area and subsequently the SMA. Then the primary motor cortex is activated. This is a rather slow process lasting some 600 - 800 mS. However much of this is simultaneously moved to the deeper parts of the brain, the basal ganglia. This programming is therefore activation from higher to lower hierarchic areas of the brain. The most important source to new planning is one based on old plans but converted to meet new situations. (Miller). When the basics of piano playing has been learned, we can play automatically and now gradually with increasing speed as our movements are now processed by our more primitive but faster striatum and cerebellum, and not by our relative slow motor cortex functions (Hlustic, Kneebone, Pavlova, Poldrack, Schiltz). It is the striatum that activate and sets the tempo in the sequential employment of the learned motor skills. Similarly, it is the cerebellum that controls these motor activities and fine-adjust running sequences of movements. The control of our surgical hand/finger movements must therefore during our training gradually be moved from cortex to striatum; that serves like our autopilot. This memory - encoded in the putamen of the striatum - stays for life and is thus less flexible than the declarative knowledge in the hippocampus. The hierarchic building of the brain explains why an operative technique - once learned as habit learning - can be performed with little or no conscious control later on (Chazan, Gerloff, Haase 2004, Milton, Pavlova).

Multitasking = flexible brain cortical function is needed to adapt to new situations occurring during our operative procedures (Milton, Schiltz). In these situations declarative memory knowledge from the hippocampus must be recalled and perhaps modified when applied to a new surgical situation like using an endoscope. Here we face a serious learning problem. Multitasking e.g. cognitive function cannot be optimally performed while the surgeon is focused on learning specific surgical movements (Ausman, Poldrack). The important point is to understand that what is stored or will be stored in the hippocampus is information that the surgeon needs to be able to reflect upon during a surgical procedure whenever e.g., catastrophes develop or changes are to be made in the procedure. Therefore the essential problem for surgical expertise is to develop the striate function for our motor dexterity - habit learning. We need to obtain much declarative knowledge about operative techniques, results etc., to develop our surgical function. If we shall have our cortex ready for the needed reflexion during surgery we must change as much as possible of our dexterity to habit knowledge. The expert-situation where the neurosurgeon acts without explicitly reflecting on the principles or rules involved but simply uses his declarative function combined with embodied striate dexterity, whereby he can perform efficiently (Haase 2004, Milton, Yasargil). Thus, through training, full-blown surgical skills will no longer be based on the motor cortex, but mainly on putamen/cerebellar functions being necessary for a flexible and adaptive cognitive performance (Adams, Barnes, Hlustic, Kochro, Patrick). When we learn through vision it is important to be motor active at the same time. All our training in developing dexterity is built on collaborate sensory information and motor exercises.

Neurosurgeon psychology profile: Apart from the previous mentioned abilities and skills, it has also been documented that the performance of a surgeon and of world-class athletes is closely linked with his psychological personality (Ausman, Jarosch, Long, McDonald). There is a parallel between the psychological dynamics of world-class athletes and expert-surgeons, specifically with relation to self-esteem and particularly positive imagery (McDonald). A neurosurgeon's mental preparations before surgery is therefore of major importance for successful operative procedures, just as it is among athletes. However, this fact is often neglected in our training and daily life. It must be understood and accepted as being an integrated part of every operative procedure (Arnold, Haase 2009, Long, McDonald, Waldron).

Teaching/ Learning - based on these new ideas: Current academic neurosurgical teaching is often based on the following "classics"

a) Reading about a certain operation, followed by
b) The see-one- and
c) The try one principle

The value of this is open for discussion (Campbell, De Graf, Kolmos, Long, Shah). Validation of this type of learning is often given by logbook monitoring e.g. how many operations of different types we have performed and on the time spent in the department. This means that we mainly monitor our learning by quantity and not by quality (www.abns.org).

Using an endoscope is a completely new mode of inhabiting, navigating, sensing, judging etc., within our operative field. This function must be developed on specific training as the neurosurgeon cannot rely on experiences obtained neither from previous normal macro- nor micro-habitats (Haase 2004, Spicer). Watching our operative field through an endoscope or a TV monitor leads to perceptual problems especially those of mental imagery (Waterworth 2003). We all know the size of a flower or a butterfly and can estimate the size of a flying aircraft from "previous macro-experience". The endoscope habitat lacks these simple definitions of sizes together with that of our normal 3D vision. The endoscope surgeon needs a 3D perception when carrying out surgery, but cannot receive this through monocular vision. How is your 3D perception acquired via the monocular endoscope? It is obtained by moving the endoscope closer or further away from an object and thereby automatically validating size changes e.g., a new way of obtaining 3D perception. This process is completely different from all we have learned so far - and takes time to acquire proficiency. Working via the monitor, seeing with two eyes the neurosurgeon is performing without normal 3D vision, as the screen is only in 2D. When introducing an endoscope into a patient, he must also learn how to find where he is in this operative space. What he sees from the tip of the endoscope does not resemble any anatomical data learned from previous experiences. With the stiff straight endoscope he must develop a perception of where the tip of the scope is in space. The hand position gives us some proprioceptive information that can be used. To complicate this task even further endoscopes may have different angled tips e.g. 0-, 30-, 60- and 90 degrees. Viewing our target may thus be from very different angles despite that we placed it the same way. This influences how we use our instruments - it is like flying an aircraft upside down. We develop skills by using these different angled scopes - but it takes a lot of time and habit learning. Using flexible endoscope it becomes even more difficult as we have to learn where the tip is situated in this habitat through vision alone and not by hand proprioception. With the endoscope it is also possible to coagulate, dissect, and cut tissue etc., exactly as with our micro instruments. The endoscope instruments are very different, being long and having new handles. Our finger proprioception already learned cannot easily be used. Before the necessary skills have been developed for moving around in this new habitat, a trainee will not have adequate capacities for multitasking = perceptual judgment in this new habitat. Experienced hand surgeons trying to develop skills with the endoscope had a 17% complication rate performing endoscope decompression of the median nerve on cadavers (Rowland). The neuro-endosurgeon needs to develop these habit-learning parts of endoscope dexterity, whereby new cognitive functions and ways of perception give him the chance to use the endoscope effectively (Gallagher, Fogg, Haase 2004, Milton, Pavlova, Sackett, Schiltz, Waterworth 1997, Waterworth 2003). When a surgeon gets familiar with the endoscope, it must become a functional part of the neurosurgeon e.g. "embodied" in his brain. Surgical techniques are therefore being developed, both through training and time (Hlustic, Kolmos, Milton). So when we introduce an endoscope in the carpal tunnel we have to learn what it looks like in real life. Here we need new imaging techniques e.g. ultrasound and MRI. When the neurosurgeon views the median nerve it is a very different view from his previous macro-experience (Grancharov, Haase 2004). When the experienced endoscope surgeon views a peripheral nerve he fuses his actual vision with what he has learned previously in his long macro training. This is for obvious reasons not possible for a trainee (Fogg, Gallagher). Obtaining experience is thus much more important in this endoscope habitat than in previous habitats. "Endoscope surgical technique requires rigorous training in order to avoid dangerous pitfalls 'experienced hand' surgeons must perform it" (Chow).

The fact that one great endoscope surgeon or similar micro neurosurgeon can carry out CTS operations without complications does not necessarily indicate that other younger and lesser-experienced surgeons will do the same.

Endoscope habitat - why is it that it changes our training scenario?
If our goal is to become excellent endoscope neurosurgeons e.g., flexible, fast and "efficient", our surgical motor skills learning must first aim at storing the needed dexterity in the striatum/putamen (Arnold, Gallagher, Haase 2004, Long, Tendick, Waldron). Currently we do not do this efficiently and we need to introduce completely new learning methods of manual function - dexterity - involving a different visual perception.

If we want to develop skills in using the endoscope, we must start by setting our own goals and we must understand the above-mentioned basics of learning (Kolmos). Through our training we shall focus on promoting transfer of our complicated manual dexterity from cortex into the striatum/putamen and cerebellum in order to preserve cognitive possibilities to handle any eventual complications during our operative procedures (Milton). These steps integrate the necessary interplay between declarative and procedural information. How can we stimulate this? Instead of random obtained declarative knowledge we should concentrate our task on the transfer of dexterity from the motor cortex into the striatum in time. This process can be forced if we concentrate our training over time (Hlustic, Milton, Pavlova).

As a consequence - if we continue to use the traditional learning model in our current neurosurgical resident training alone, this may result that we never exceed the first Dreyfus stage of learning (Haase 2009)!

The new learning model proposed emphasizes:
Primarily - the dexterity moved to the putamen removes some of the cognitive load on the brain cortex, thereby relieving brain resources for other purposes during an operation, such as decision-making, or being aware of relevant changes in the actual circumstances for carrying out a certain routine.

Secondly - the more this motor function is carried out via the basal ganglia without vesting time using the primary motor cortex; it will result in a fluent dexterity 'flow' and thus a better performance.

Thirdly - better timing of our learning.

The learning curve is individual and important. When we learn it is better to do it continuously instead of over longer time. This is illustrated in Figs 2 and 3.

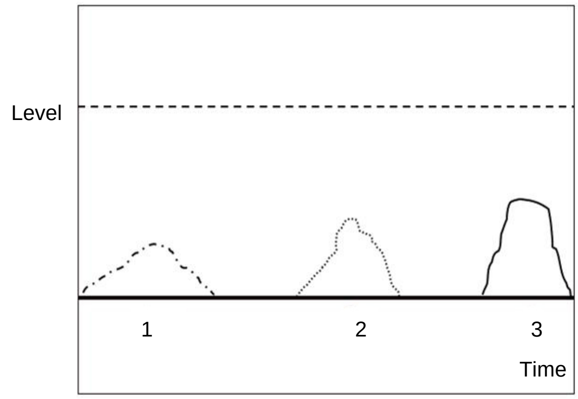

Figure 2 - Illustrates the level of expertise we need to obtain. Here with 3 different courses several months apart we never reach the level we wanted.

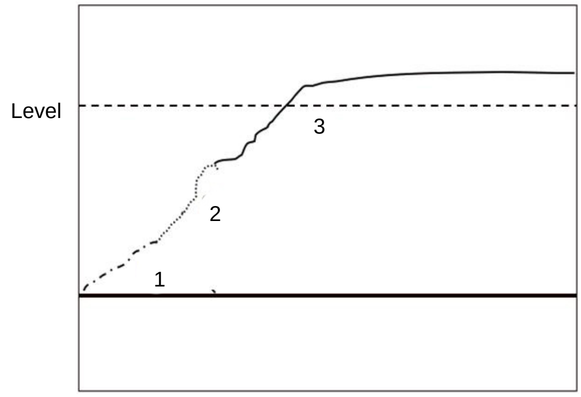

Figure 3 - Here we reach it by adding the same 3 courses in a continuous manner, thereby storing our dexterity skill in the striatum - where it stays "forever".

The important issue is that processing dexterity from cortex to putamen takes time and is best performed in a continuous manner. The traditional way is neither fit for this learning nor for endoscope learning.

How can we further promote this process?
Fourthly - sleep. The reader may not believe it but

through sleep! Our memory function is actually promoted by sleep. Sleep does not just passively protect memories, but plays an active role in memory consolidation (Datta). Memory obtained persists across the subsequent waking day, even when challenged by new information. The same is the case for sleep. Taking a stimulant to stay awake can in the short term help with alertness, but people really need sleep to retain memory and function at their best (Datta, Ellenbogen). In our classical training system we tend to do the opposite and keep the trainees awake performing unnecessary duties for long hours - without sufficient REM-sleep.

Fifthly - Focus and goal setting: We must as trainees (and we all are in endoscope surgery!) ask ourselves:

- What shall I be able to do?
- What shall I know in terms of declarative knowledge (on procedures and anatomy and so forth)? and
- How shall I train to acquire the necessary know-how, given my current skills, abilities and personality?
- After a training session, it is further important to reflect on it with a debriefing:
  - What did I learn?
  - How good is my performance using what I learned?

The trainee must therefore - for himself - secure:

- Personal procedural knowledge goals, e.g., what degree of dexterity he needs, how fast he should be in suturing a knot with the endoscope.
- Develop personal methods/ protocols on how to reach these goals.
- Secure personal validation of how these goals are reached.
- Learn to use the now trained dexterity in settings that simulates the operative environment with all its distractions (sounds, lack of communication, work from TV monitor, stress etc.).

Keeping track of one's own learning this way will be rewarding and, most importantly, motivating (Arnold, Ausman, Kochro, Kolmos, Long, Spicer). Learning is a group-monitored and group-oriented process and not a simple 'result-oriented' task (De Graf, Haase 2004, Kolmos). This may also be partly obtained through training in special settings such as Virtual Reality (Arnold, Haase 2004, Kochro).

Conclusion

Regarding learning endoscope technique of Carpal Tunnel Release:

The more experienced surgeons "seniors" giving lectures and writing papers telling young trainees about new techniques - because we "invented" them. Many published surgical series are thus "personal" by neurosurgical experts and are perhaps not suited for generalizing - which is still happening even today. Complication rates for both open (OCTR) and endoscope CTR (ECTR) procedures are usually low in these "expert" papers (Agee, Atroshi, Chow, Jimenez, Palmer, Scholten). Training courses in endoscope decompression are multiple - in open surgery very few, probably because "it is so simple". Release of the median nerve (CTR) for the treatment of carpal tunnel syndrome (CTS) can be one of the most straightforward and satisfying procedures performed by a neurosurgeon. The new UEMS charter (Steers) emphasizes this and training surgical techniques is soon an integrated part of all surgical programmes and is today part of the formal EANS training courses today (www.EANS.org). We must therefore focus on the learning scenario, develop our endoscope habit-learned technique faster over time, introduce necessary sleep pattern in the training period and keep track of our progress in the training.

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